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Europe/Latin America Report

SCIENCE AND TECHNOLOGY

ITALY: DEVELOPMENT PROSPECTS FOR

TRANSPORT, PHARMACEUTICALS, AEROSPACE

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ITALY: DEVELOPMENT PROSPECTS FOR TRANSPORT, PHARMACEUTICALS, AEROSPACE

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[Excerpts of the third and final part of the report of the Italian Prime Minister's Committee for Science and Technology: "The Transport Sector" by Carlo Eugenio Rossi; "Pharmaceutical Industry Research and Development" by Silvio Garattini and Renato Ugo; and "Aerospace Industry: Technological Evolution and Prospects for Italy" by Bruno Colle with the collaboration of Angelo Airaghi; date of issue not given]

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The Transport Sector

2.1 Introduction

Today the transport sector (especially means of transportation) represents a significant example of the internalization of the most important breakthroughs made in the fields of applied science and technology.

In this connection, let us refer to the following:
--The widespread use of informatics in designing and manufacturing techniques (CAD-CAM) [Computer Aided Design--Computer Aided Manufacturing];
--The fact that the automobile industry offers a wide range of opportunities for testing the most advanced technologies (e.g., laser technology);
--The application of microelectronics and of microprocessors onboard vehicles in order to optimize their performance;
--The increasingly widespread adoption of new materials, which often find their first major industrial application in the automobile industry;
--The introduction of new technologies into the organization and management of transportation through the adoption of computerized systems for controlling urban and railway traffic as well as the management and distribution of goods.

The development of a General Transportation Plan (PGT), which is currently in progress, clearly testifies to the major role played by this industry in the country's economy as a whole.

The plan is expected to provide indications and a framework for subsequent investment initiatives and regulations, on the basis of which a balanced intervention scheme will be developed to meet specific requirements within the sector.

A major aspect of this plan is the ability to relate problems concerning the industry's development to science and technology.

2.2 Resources

--The main R&D indicators in the transportation industry are shown in Table 8. The extent of the financial and human resources devoted to research by the transportation industry is a clear indication of the preeminence of this sector in our country's continuing progress toward innovation.

A 1983 Confindustria survey concerning expenditure on research in the private sector of industry shows that the transportation sector accounts for approximately 1/4 of the total (see Table 9). This

commitment to innovation is further emphasized when one considers research spending as a proportion of total sales: 6.5 percent for means of transportation, a figure which compares favorably with the figure for electronic machines (see Table 10).

2.3 Results

--The data set out in the preceding section highlighted the financial effort made by the domestic road transportation industry to innovate both [in terms of] its products and [of] its manufacturing processes.

What results were achieved by this effort? A tentative answer to this question--even though a partial one, for the very complexity of the sector would demand a detailed and highly technical analysis--is provided in the following subsections.

In addition to this, let us recall that each and every result can be seen in its real perspective only if it is set against the results achieved by other countries which are committed -- as is Italy -- to large-scale technological innovation. However, the scarcity and/or total absence of data on the international level seriously hinders any such comparison; consequently, the analysis must be limited to large statistical aggregates alone. Nevertheless, these may be considered a fairly good indication of the technological standard attained by our country.

2.3.1 Technological Standard of the Manufacturing Processes

While assembly with extensive use of robots may double productivity, the adoption of CAE (Computer Aided Engineering) systems offers the opportunity to cut design times by more than two-thirds.

According to estimates by the American industry, the introduction of automation may lead to important improvements by reducing the costs and time involved in product development while helping achieve higher quality standards (see Figure 7).

--As noted earlier, not only has the development of Italy's road transportation industry always kept up with the industry's development worldwide, but has now reached a stage where it is leading in process automation with robot density exceeding that of the most advanced countries (see Table 11).

--This situation, however, should not foster undue optimism concerning the future of the industry. Intensive automation, as a means of making products more competitive, has now become a major target for all manufacturers. This applies particularly to the Japanese, who are

planning to boost robot penetration in their main manufacturing operations (see Figure 8).

--These forecasts are of particular significance for the automobile industry, and should be considered in a world context characterized by:
--A decline in average profitability from 22 percent in 1950 to 5-6 percent in the early 1980s;
--A process of concentration in the number of automobile manufacturers (see Figure 9).

There is indeed a link between these two processes, in that the former has ousted the weaker competitors and forced them to join with larger companies. An additional factor is the current trend toward internationalization of the main automobile companies, with the establishment of joint ventures for the production, supply or exchange of specific vehicle components (engines, transmission, gearboxes, automatic systems, etc.).

2.3.2 Technological Standard of the Products

--Automobiles, commercial and industrial vehicles, buses and motorcycles are the main production areas of the road transportation industry. Each category is divided into segments defined by distinctive parameters (such as cylinder capacity, and weight), and an in-depth evaluation of the technological standards of the products is made all the more difficult by the lack of truly representative, up-to-date statistical data. However, a tentative assessment can be made with respect to the reduction in fuel consumption by automobiles.

--This assessment is based on the following concept: up to the early 1970s, automobiles were regarded as mature products in terms of their technological content. This assumption, however, was overturned by the energy crisis, which demonstrated the fuel-saving potential inherent in some innovative technologies applied to automobile production, for example, electronics and informatics, new materials, and improved design techniques.

To put it another way, each and every significant reduction in vehicle consumption is the result of advanced technological innovation and, therefore, may be taken as a reliable indicator of the technological standard reached by the manufacturer in question.

--The concept expressed in the preceding paragraph receives greater justification when we consider the complexity of the operations required to cut vehicle consumption:

--Reduction in the aerodynamic penetration coefficient;
--Reduction in dead weight;
--Reduction in tire rolling resistance;
--Reduction in transmission losses;
--Reduction in organic engine losses;
--Increase in thermodynamic efficiency.

--On the basis of these parameters, a statistical assessment has been made of the results achieved in reducing fuel consumption on Italian automobiles, and these results are then compared with the ones obtained by other leading manufacturing countries using advanced technologies.

The assessment is made:
1. In terms of overall vehicle range.
2. In terms of vehicle category.

1. The indicator used for overall vehicle range assessment was the average yearly reduction (as a percentage) in consumption over the period 1979-1982 (see Table 12).

Naturally, these data should be considered in conjunction with the product range on which the energy savings are effected. A percentage reduction in consumption in a small/medium-sized European vehicle undoubtedly is more difficult to achieve than a similar reduction in a large American vehicle.

By way of example, Table 13 shows the percentage distribution by weight of the new automobiles produced by a number of manufacturing countries. Having said this, the figure shown for Italy in Table 12 definitely reflects an excellent result.

2. The second indicator considered (see Table 14) is based on the average consumption (1/100 kms) recorded in urban traffic for four categories of weight.

The results indicate [that there is] fierce competition between all the countries in each weight category. Also, they show that Italy's position may be considered, on the whole, more than satisfactory. As no data were available concerning the range of new vehicles in 1982, an attempt was made to determine the average value of the indicator by weighting it using the data on the 1980 vehicle range given in Table 13. The results, which are intended to provide merely a rough indication, are shown in Table 15.

2.4 Relationships Between Government Intervention and Corporate Research

--A wide range of organizations are currently involved in specific research in the transportation sector. These include: universities, CNR [National Research Council], public bodies and state-controlled companies (FS [Italian Railroad Company], CETENA [Center for Studies of Naval Technology], and so on), and specialized industries.

--In addition to these, a number of government agencies are allocating funds for research in the transportation sector, for example, CNR Finalized Projects (transportation, energy II, etc.), IMI Fund for Applied Research, Fund for Technological Innovation (Act 46/1982), funds allocated directly by universities, the CNR, or the FS.

--The considerable fragmentation of the administrative functions, which are divided among the various ministries and bodies, has proved to be a serious hindrance for the definition of an overall strategy for all the transportation subsectors, each one of which is characterized by specific, often highly diversified technical and production features--both in the services offered and in the technologies employed--and by radically different rates of development.

--Specific support tools for research in the transportation sector include the Finalized Projects developed by the CNR.

The first of these is the Finalized Energy Project, started in 1976 with limited financial resources (12 billion lire over 5 years) allocated to the transportation sector. Work on a Finalized Transportation Project (PFT), designed to deal with problems of research and innovation in the transportation sector in a comprehensive manner, was started only in 1981.

In the wake of these CNR-sponsored projects and initiatives, the industry has been making a considerable effort to identify and develop some highly innovative plans in cooperation with the public agencies (CNR and universities).

By promoting and coordinating action through implementation of the PFT, the CNR is contributing to the development of the transportation sector in two respects. On the one hand, it is attempting to outline and provide a sound basis for technological development in means of transportation and, on the other, to focus on the problems affecting the sector as a whole, developing suitable tools for quantitative analysis that will provide reliable forecasts of future trends.

Technological development tends to boost the supply side and to rationalize the demand side. In both directions, the PFT reflects a continuing commitment to concentration of the research effort required and a rapid transfer of the results produced to the end-product, for the social benefit of users.

--The National Transport Research Plan (PNRT), prepared in 1983 by the Ministry of Scientific Research, is designed to coordinate the research activities carried out by the various agencies and to utilize the relevant government allocations within an overall framework of general objectives connected to the objectives established in the medium-term plan.

The main [general] objectives are:
--To improve the efficiency and productivity of services, means of transportation and infrastructures;
--To cut fuel consumption;
--To improve the relationship between the transportation system and the surrounding environment;
--To make domestic products and services more competitive in foreign markets.

These objectives will have to be pursued in close connection with the interventions referred to earlier, which are expected to become effective with the implementation of the more extensive General Transport Plan.

Chapter Three

Short-Term Prospects and Areas of Intervention

3.1 Prospects

There is a tendency in the technical and industrial fields to replace the old distinction between "innovative" and "mature" sectors with the new concept of "intersectoriality" of the development trends in production (Nomisma document).

--This tendency stems from the recognition of a powerful drive toward innovation as a result of the major transformations now in progress in the following areas of modernization (see Table 16):

--Production inputs
--Methods of production
--Production management systems.

--A significant example of "intersectoriality" is supplied by the automobile industry, where innovative developments resulting from the above areas of modernization are increasingly tending to affect products and process technologies at a horizontal level.

As shown in Table 17, the transportation industry is involved in almost all the areas of application of the new methods of production.

3.2 Areas of Intervention

1. If "intersectoriality" is --as, indeed, it seems to be--the new short- and medium-term strategy in industrial policy, then action in the interests of society as a whole must take the form of government intervention and focus on the development of an overall policy capable of coordinating and supporting the growth of Italy's manufacturing system in line with the modernization trends stated in section 3.1.

This policy hinges on technological innovation made available by research, and research activities themselves should be carried out in accordance with the suggestions made, on a more general level, for implementation of an industrial research policy.

2. Points of major interest in these suggestions include recognition of:

--The critical role that may be played by the creation of a suitable environment for the spread of technological innovation throughout the manufacturing system;
--The importance of considering the various stages in the process of innovation (research, development, prototype production, preindustrialization, and marketing) as a unified process;
--The need to establish some kind of coordination among industry, universities and public research bodies, both in the implementation of the innovation process and in the training, retraining and mobility of human resources.

Finally, government action should comply with the guidelines defined by an overall policy capable of ensuring:
--The continuity and soundness of any government intervention in the area of innovation;
--The promotion and coordination of programmed state-sector demand;
--Fiscal and/or financial incentives of an automatic and immediate type.

3. In particular, as far as the road transportation sector is concerned, special emphasis should be placed on the main problem areas

connected with the technological evolution of motor vehicles. These are:

--Reduction in consumption;
--Reduction in emissions;
--Increased safety, reliability and quality;
--Reduction in manufacturing costs.

These problems can successfully be confronted only if both industry and the public research agencies cooperate and lend substantial, continuing support to research and development activities.

In this connection, the approval and implementation of the National Transport Research Plan (PNRT) in conjunction with the General Plan would mark a first important step toward solving these problems.

Table 8 R&D Indicators in the Transportation Industry

	ISTAT Data (1981)	
1. Industrial research expenditure	534	Billions
Percentage of total expenditure for ind. research	23.3	"
Percentage of the country's total expend. research	13.2	"
2. Personnel employed by the industry for research on transport	10.718	"
Percentage of total engaged in industrial research	21.3	"
Percentage of the country's total payroll expenses for research	11.3	"

Table 9 Expenditure for Scientific Research
(millions of lire)

1. SETTORI	1979	2. CONSUNTIVI 1980	1981	1982	3. PREVISIONI 1983	1984
4. Alimentari e affini	3.806	4.797	6.092	7.337	9.222	11.794
5. Tessili e abbigliamento	2.241	2.298	3.363	4.548	5.658	6.140
6. Metallurgiche	7.140	7.841	11.190	12.121	14.714	14.266
7. Meccaniche	247.587	311.230	425.034	520.494	615.191	700.471
8. Costruzione macchine utensili	1.070	1.490	2.439	2.581	2.999	3.170
9. Costruzione macchine per ind. e agr.	30.558	33.820	38.098	40.783	52.536	58.242
10. Meccanica di precisione	10.906	12.546	14.934	20.714	30.047	35.950
11. Costruzione macchine elettriche	16.110	21.413	23.704	28.293	33.975	38.271
12. Costruzione macchine elettroniche	70.893	88.600	121.359	146.846	178.105	202.973
13. Costruzione elaboratori	75.964	104.409	160.461	198.943	232.611	266.507
14. Altre meccaniche	42.006	48.864	63.959	74.334	84.918	85.350
15 Costruzione mezzi di trasporto	249.102	281.133	320.094	398.545	451.036	489.481
16 Lavorazione minerali non metalliferi	4.833	5.880	7.014	11.316	14.978	16.195
17 Chimica	111.243	151.342	167.596	192.903	205.130	226.290
18 Produzione di prodotti farmaceutici	117.502	144.429	180.602	221.941	290.979	341.174
19 Derivati del petrolio e carbone	5.770	7.717	10.056	12.099	13.115	14.113
20 Gomme	51.962	65.877	80.240	93.864	100.159	121.681
21 Altre industrie	60.449	69.126	76.694	91.155	112.444	133.973
22 TOTALE	861.643	1.051.670	1.295.983	1.566.323	1.840.626	2.075.570

23 da: Centro studi Confindustria - «La spesa dell'industria privata per la Ricerca scientifica: 1979-1984» - novembre 1983

Key:
1. Sectors
2. Final
3. Estimated
4. Food & related items
5. Textiles and clothing
6. Metallurgical
7. Mechanical engineering
8. Machine tool manufacturing
9. Manufacturing of machines for industry and agriculture
10. Precision machines
11. Electric machine manufacturing
12. Electronic machine manufacturing
13. Processor manufacturing
14. Other mechanical engineering areas
15. Manufacturing of means of transportation
16. Processing of non-metalliferous ores
17. Chemicals
18. Production of pharmaceutical products
19. By-products of oil and coal
20. Rubber
21. Other industries
22. Total
23. Source: Centro Studi Confindustria - "La spesa dell'industria privata per las Ricerca scientifica: 1979-1984"--November 1983.

Table 10 Scientific Research Expenditure as a Percentage of Total Sales

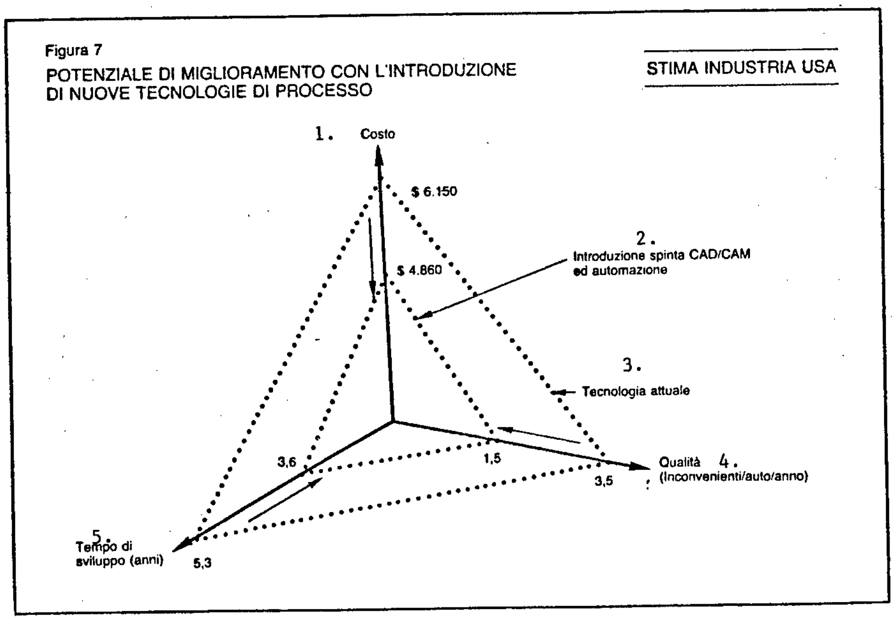
1. SETTORI	2. CONSUNTIVI				3. PREVISIONI	
	1979	1980	1981	1982	1983	1984
4. Alimentari e affini	0,17	0,19	0,18	0,18	0,20	0,24
5. Tessili e abbigliamento	0,51	0,49	0,59	0,08	0,76	0,72
6. Metallurgiche	0,53	0,47	0,67	0,68	0,76	0,88
7. Meccaniche	1,32	1,32	1,57	1,67	1,70	1,64
8. Costruzione macchine utensili	1,40	1,65	2,18	2,31	2,60	2,58
9. Costruzione macchine per ind. e agr.	2,13	2,02	1,89	2,19	1,88	1,81
10. Meccanica di precisione	2,72	2,81	2,83	3,53	4,64	4,90
11. Costruzione macchine elettriche	0,97	1,03	0,96	1,01	1,02	1,02
12. Costruzione macchine elettroniche	6,08	4,67	6,99	6,42	6,83	6,23
13. Costruzione elaboratori	0,71	0,79	0,99	1,00	1,06	1,01
14. Altre meccaniche	1,28	1,16	1,54	1,70	1,82	1,83
15. Costruzione mezzi di trasporto	6,78	6,04	6,14	6,58	6,45	6,22
16. Lavorazione minerali non metalliferi	0,62	0,57	0,58	0,61	0,69	0,64
17. Chimica	1,20	1,39	1,38	1,44	1,48	1,60
18. Produzione di prodotti farmaceutici	7,55	7,39	7,47	7,59	8,21	8,16
19. Derivati del petrolio e carbone	0,18	0,16	0,17	0,19	0,17	0,17
20. Gomme	0,50	0,47	0,48	0,50	0,47	0,48
21. Altre industrie	2,61	2,61	2,30	2,88	2,87	2,94
22. TOTALE	1,60	1,54	1,62	1,73	1,76	1,77

23. da: Centro studi Confindustria - «La spesa dell'industria privata per la Ricerca scientifica 1979-1984» - novembre 1983

Key:
1. Sectors
2. Final
3. Estimated
4. Food & related items
5. Textiles and clothing
6. Metallurgical
7. Mechanical engineering
8. Machine tool manufacturing
9. Manufacturing of machines for industry and agriculture
10. Precision machines
11. Electric machine manufacturing
12. Electronic machine manufacturing
13. Processor manufacturing
14. Other mechanical engineering areas
15. Manufacturing of means of transportation
16. Processing of non-metalliferous ores
17. Chemicals
18. Produciton of pharmaceutical products
19. By-products of oil and coal
20. Rubber
21. Other industries
22. Total
23. Source: Centro Studi Confindustria - "La spesa dell'industria privata per las Ricerca scientifica: 1979-1984"--November 1983.

Figure 7 Potential for Improvement Through Introduction of New Process Technologies

USA Industry Estimate



Key:
1. Cost
2. Intorduction of intensive CAD/CAM and automation
3. Present technology
4. Quality (faults/cars/year)
5. Development time (years)

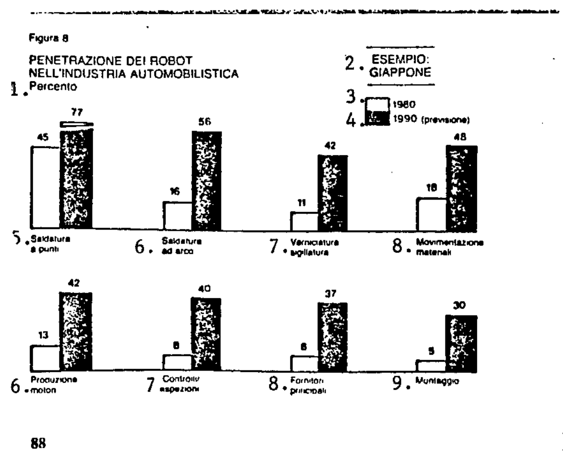
Table 11 Robots Installed (1982) By Leading Automobile Manufacturers

	1 • N. di robot in servizio	2 • N. di robot in servizio per 1000 vett. prodotte
Toyota	1.250	59
Nissan	1.300	45
Mazda	360	32
Honda	340	34
Mitsubishi	230	24
Vw	820	55
Renault	240	14
Psa	200	15
Fiat	600	60
Ford (W.G.)	250	48
Ford (U.K.)	160	38
Opel	40	4
U.S. GM	2.300	57

3. *Fonte:* Nomura

Key:
1. Number of robots used
2. Number of robots used for every 1,000 vehicles produced
3. Source: Nomura

Figure 8 Robot Penetration in the Automobile Industry



Key:
1. As a percentage
2. Example: Japan
3. 1980
4. 1990 (forecast)
5. Spot welding
6. Arc welding
7. Painting/sealing
8. Handling of materials
9. Engine production
10. Monitoring/inspection
11. Main suppliers
12. Assembly

Figure 9   Number of Automobile Manufacturers in the World

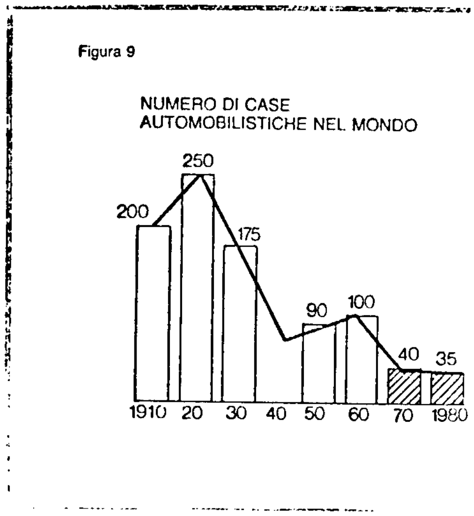


Table 12

Germany	-2.9
Italy	-2.5
Japan	-2.9
Sweden	-1.9
United Kingdom	-1.5
USA	-4.8

Source: IEA

Table 13

	(1980)	
1. Germania	0- 800 kg	20%
	801-1.000 kg	40%
	1.001-1.200 kg	20%
	>1.200 kg	20%
2. Italia	0- 800 kg	43%
	801-1.000 kg	43%
	1.001-1.200 kg	10%
	>1.200 kg	4%
3. Svezia	0- 999 kg	26%
	1.000-1.200 kg	26%
	>1.200 kg	48%
4. Regno Unito	0- 800 kg	29%
	801-1.000 kg	43%
	1.001-1.200 kg	19%
	>1.200 kg	9%
5. Usa	0- 829 kg	3%
	830-1.056 kg	25%
	1.057-1.170 kg	10%
	>1.170 kg	62%

Fonte: Iea

Key:
1. Germany
2. Italy
3. Sweden
4. United Kingdom
5. USA

Source: IEA

Table 14 (1982)

Liters/100 km - Urban traffic

	up to 800 kg	801-1000 kg	1000-1200kg	>1200 kg
Germany	7.6	9.1	10.3	11.9
Italy	7.3	8.2	11.3	8.8
Japan	6.1	6.7	8.1	10.9
United Kingdom	7.9	9.8	10.5	13.6
USA	7.4	8.2	10.6	12.3

Source: IEA

Table 15

Germany	9.6 1/100 km
Italy	8.1 1/100 km
United Kingdom	9.7 1/100 km
USA	10.9 1/100 km

Table 16 Synoptic Table of the Lines of Modernization

Modernization of Production Inputs

a) New Materials:
   - a-1) plastics (polymers and elastomers)
   - a-2) materials for electronics (semiconductors, materials for sensors and transducers, materials for passive components)
   - a-3) composite materials (reinforced plastic, reinforced metal, reinforced ceramics
   - a-4) technical ceramics (for microelectronic,thermomechanical, and other applications)
   - a-5) titanium;

b) Electronic Components (integrated circuit design).

Modernization of Methods of Production

a) Production Systems and Services
   - a-1) N/C machine tools, robotics, flexible production systems
   - a-2) Computer Aided Design (CAD) and integrated CAD-CAM systems
   - a-3) Manufacturing services (customer service, maintenance, personnel training, type-testing and specifications to accepted standards);

b) Biotechnology.

Line of Modernization Concerning Production Management

a) Informatics--microinformatics (in manufacturing processes, office work, bank transactions, business, trade)

b) Informatics-related services

c) Telecommunications and telematics

Source: Laboratorio di Politica Industriale

Table 17 Fields of Application of the New Production Methods

Production Area	Method of Production	Notes
Motor vehicles (mass production)	(2)-3-4-5-6-7	(2) prod. unit with limited use
Motorbikes (mass production)	(2)-3-4-5-6-7	
Sports cars and motorbikes, prorotypes, pre-prod. models, spares for discontinued products	1-2	
Trucks	(1)-2-3-4-5-6-7	(1) prod. unit with limited use
Tractors	(1)-2-3-4-5-6-7	
Earth-moving machines	1-2-3-4-5	
Avionics	1-2	
Small/medium-sized marine and industrial engines	1-2-4-5	
Light armaments	6-7	
Heavy armaments	1-2-4-5	
Components	2-3-4-5-6-7	
Electrical appliances	6-7	
Railroad	1-(2)	(2) prod. unit with limited use
Lift trucks	1-2-4-5	
Petrochemical	1-2-4-5	

(1) Work centers
(2) Flexible processing systems
(3) Transfers of "closed" groups of units
(4) Shuttle systems
(5) Stationary systems
(6) Rotary table systems
(7) Non-flexible transfers.

Pharmaceutical Industry Research and Development

As far as the [pharmaceutical] industry in the year 2000 is concerned, production is expected to be concentrated in multinational enterprises, while new biotechnological processes will become increasingly widespread. Indeed, the latter are expected to produce changes comparable to the ones brought about by the therapeutic revolution of the 1930s and 1940s. In addition, new drugs designed to combat mental and metabolic diseases, hypertension, rehumatism, aging and tumors will be introduced into the market.

Considerable emphasis is placed on biotechnological research in the United States (where, incidentally, the fiscal system provides a powerful stimulus for R&D investment and for the establishment of business enterprises through capital-ventures), and in Japan (where extensive coordination between the research bodies and the enterprises is ensured by MITI [Ministry of International Trade and Industry]. In particular, Japan has considerable experience in the field of fermentation, as well as considerable experience in the implementation and industrial application of know-how and patents obtained under license. In the EEC, a vast program is currently in progress, but it should also be noted that some members of the Community (West Germany and, more recently, the Netherlands) have already made allocations for financing innovative activities in biotechnology.

The implementation of specific policies designed to support the pharmaceutical industry--which has already been done in different forms and on varying scales by several countries--seems bound to play an increasingly important role in the transformation of the sector over the next 15-20 years. At present, this policy is being implemented primarily through the following measures the allocation of financial resources for R&D and innovation, either directly or indirectly (for example, tax deductibility of investments made in R&D and innovation; product pricing to offset, either partially or totally, R&D and innovation expenditure); the more or less overt protection of domestic products (in this way, vaccines may be imported into Japan only on condition that the various groups of micro-organisms are isolated on the spot); the introduction of incentives specifically designed to facilitate the internationalization of enterprises. Conversely, no really satisfactory steps have been taken so far to meet existing demands for an extension of the period of validity of patents (the considerable lapse of time intervening between the development of a pharmaceutical product and its marketing impairs the vendor's exclusive rights) and a substantial reduction in the cost and time required for patent registration (the reasons are similar to the ones stated earlier, but the effects would be even more significant if a standard procedure were introduced). A partial answer to these demands has been

provided by recent American legislation ruling that patent rights may be extended by another five years (provided that sound evidence is produced showing that the launch of the products was delayed in order to ensure compliance with FDA [Federal Drug Association] standards) and stating that manufacturers should not have the right to market products which are equivalent to the ones already on sale. Both these steps, however, have been harshly criticized.

It is quite clear that the governments of all the industrialized countries will have to find definite solutions to these problems in the near future.

Naturally, there are no really significant differences between the problems confronting Italy's pharmaceutical industry and the relevant solutions, and those experienced by other countries. On the other hand, it should be emphasized that Italy is lagging behind other countries in this field and has a precarious international position, and this requires greater efforts to be made and firmer commitment to the necessary goals, the most important of which is to attain, in the shortest time possible, a high level of production capability to meet the challenge of international competition.

Innovation and internationalization are universally considered to be critical success factors. Indeed, the former is responsible for maintaining a continuous, high flow of new products while the latter ensures widespread application and offers an indispensable basis for marketing the products worldwide. Consequently, any political action seeking to revive Italy's pharmaceutical sector must focus on these two factors.

Besides increasing its efficiency (by selecting specific areas and concentrating its efforts), Italian R&D in the pharmacuetical sector must reach a size comparable with that of other leading manufacturing countries such as Switzerland, France, and the United Kingdom. In practical terms, this means that the present level of expenditure must at least be doubled. As it is quite clear that domestic companies (which, on the whole, have limited sales, are not export-oriented, and have a limited return on investment) are not in a position to supply the additional investment required, the situation calls for specific forms of government intervention with the following objectives:

--Promote self-financing in industrial R&D at optimal levels. This may be achieved by acting both on company earnings (namely, changing the present pricing policy and streamlining the procedures to be followed for the registration and inclusion of the products in the pharmaceutical handbook), and on company costs (toxicological and

clinical testing performed by international public bodies involving training and specialization of personnel);

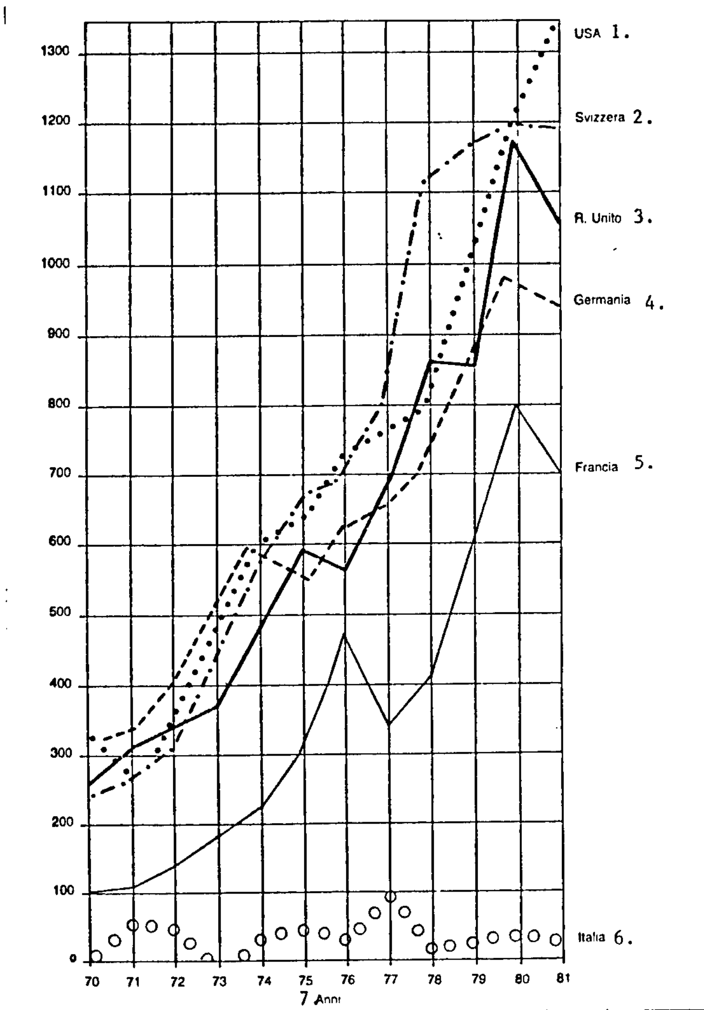
--Offer incentives for industrial R&D; primarily, this means ensuring a high degree of flexibility in the allocation of funds, making sure that R&D activities are pursued consistently, applying in full the provisions set out in Act 46/1982. The existing procedures should be modified to streamline bureaucratic activities and contract management.

Following the trend set by other countries, Italy too could adopt indirect measures (total fiscalization of the social service payments of R&D employees, tax-deductibility of any profits reinvested in R&D, etc.), since these appear to stimulate a greater commitment to R&D by pharmaceutical companies;

--Provide support to establish adequate levels of R&D in the pharmaceutical industry. Innovative research in this sector means that a specific size has to be reached, and this is much higher than the sizes involved in other industrial sectors. Therefore, the spread of this type of research must be pursued through the identification of measures capable of ensuring effective cooperation between small- and medium-sized enterprises. As consortiums and research ventures are most effective in their work when the established goal is the industrialization of results, the stipulation of agreements between the parties involved is a necessary premise. This kind of action also provides a basis for the establishment of a sound production structure and, therefore, enhances the country's competitive potential at an international level.

In order to achieve a higher degree of internationalization for the sector, two possible courses of action exist: first, an effort should be made to support exports; second, the present trend must be reversed by encouraging domestic companies to acquire shares in companies located in foreign countries. Whatever the case, there can be no doubt that the main thrust will be provided by the introduction of new products with remarkable therapeutic properties, developed by domestic industry through a consistent commitment to innovative R&D.

OSCE - Balance of Trade in the Pharmaceutical Industry for the Main Industrialized Countries of the West - Period 1970-81.



Key:
1. USA
2. Switzerland
3. United Kingdom
4. Germany
5. France
6. Italy
7. Years

Aerospace Industry: Technological Evolution and Development Prospects

2. The Technological Situation in the Aerospace Sector and Development Trends

2.1--The situation in technological development in the aerospace sector shows that the major objectives today are the following:
--To increase technical and/or mission capabilities for aircraft;
--To reduce operating costs (Figure 2).

For understandable reasons, military applications still constitute the test bench for more sophisticated technologies until the necessary technical experience is acquired and the technology is applied at an industrial level in commercial models (a recent example of this being laser inertial navigation). Great emphasis is placed on the search for increased performance in the space sector as well.

With regard to operating costs, engineers pay special attention to the so-called life cycle cost when evaluating aircraft. For example, a major effort is being made to reduce fuel consumption in civil aircraft by improving transportation fuel consumption (fuel per passenger-kilometer).

Figure 3 shows a graph of the increase which it is hoped to achieve as part of the overall technological evolution during the final 15 years of this century.

In the military sphere, and in parallel to these attempts to upgrade performance, another trend is becoming more pronounced than in the past, represented by the increasing emphasis placed on the reduction of maintenance costs. Operating costs also play a decisive role in space transportation systems, which are designed to be reusable (the space shuttle).

2.2--One of the fundamental objectives in the development of space systems is what is known as the "commercialization" of space, where tangible prospects already exist:

--In the United States, annual government revenues for satellite telecommunications alone (from industry, operators, and subscribers) are greater than the total amount invested in this sector by NASA from 1960 to 1970, the period in which the budget for this sector reached its peak;
--New markets such as the industrial use of microgravity are opening up (according to some estimates, by the end of the century this market will be worth more than $40 billion per year in pharmaceutical products, the treatment of semiconductors, and other applications).

2.3--The major areas of technological development are:

--aerodynamics and flight controls;
--structures and materials;
--systemics and avionics;
--propulsion;
--production processes and methods.

The most important characteristics of each of these areas are summarized in the following paragraphs.

Aerodynamics and Flight Controls

Traditionally, progress in aerodynamics has concentrated on reducing consumption by improving the overall performance of the aircraft for a given power/thrust [ratio]. To gain more in-depth knowledge of this area, computers operating at maximum calculating capacity available today are being used to solve equations of fluid dynamics theory. These computers make it possible to optimize the aerodynamic configuration of the aircraft while at the same time reducing substantially both the financial outlay and the time required for testing in wind tunnels and in-flight testing of the aircraft.

Thanks to the extremely high level of integration created between the overall architecture of the aircraft and characteristics of stability, performance and control logic, combined with the use of digital systems to control the aircraft, the sector of flight controls has represented a rich area of development since the 1970s.

Today we are in the phase of applying so-called active flight controls, which regulate flight dynamics in conditions of artificial stability through special "control chains" between sensors, computers, transmission of commands and pilot, with an elevated degree of man-machine interaction.

In short, the implementation of these active controls means that it is possible to fly in conditions of artificial stability, and to control structural stresses, aeroelastic vibrations and the effects of turbulence. In turn, this means that the total weight of the aircraft can be reduced while at the same time increasing the level of comfort inside the aircraft.

Adoption of a system of flight controls of this kind is accompanied by the use of electro-hydraulic servomechanisms for actuating the control surfaces of the aircraft by means of electrical control lines (the so-called fly-by-wire system); in addition, the adoption of fiber optics has promising applications for the near future ("fly-by-light"). The

next step will be "voice controls" for the pilot, a system which is already being tested.

Structures and Materials

Extensive innovation in both design and applications has been achieved in this sector over recent years with the introduction of new, so-called composite materials made of fibers and immersed in a matrix of thermohardening resin. Manufactured using special processes not only for the different materials but also for the finished components to be produced (rolling and winding, for example), composite materials possess characteristics of specific resistance and other operating characteristics (such as fatigue and coefficient of linear expansion) that are far superior to those of conventional materials such as light alloys. In addition, use of these materials is revolutionizing the approach to the design and calculation of structures since, as these materials are essentially anisotropic materials, the aircraft geometry and the distribution of masses can be optimized more effectively.

In aerospace applications, the term "advanced" composite materials refers to the combination of either a polymer bonding "matrix" (epoxy, polyamide, bismuth [bismaleimidiche] and polyester resins) with carbon, glass and kevlar fibers or, alternatively, a metal matrix (aluminum or titanium alloys) with fibers of silicon carbide or aluminum and other materials. Today, composite materials with a metal matrix are still at the stage of laboratory testing or are being used for special applications such as the space shuttle.

The "composite materials revolution" offers a potential weight reduction of up to 50 percent, together with a substantial reduction (30 percent) in production and assembly costs. It is estimated that by the year 2000 there will be a substantial redistribution in the percentage of the various types of innovative materials utilized in aircraft structures, as well as in space applications (satellites and large structures) (Figure 4).

Though less exciting, considerable progress has also been made in conventional materials, which are obviously "forced" to be more competitive. These materials include new types of light alloys (using lithium) with a greater specific resistance. Finally, steady progress is being made for engine applications, with the production of superalloys for high-temperature conditions and of new ceramic materials.

Systemics and Avionics

Over the last 15 to 20 years, developments in avionics systems, instrumentation, and on-board installations have followed the revolutions in microelectronics and other innovative technologies that have progressed beyond the laboratory stage (such as fluidics, optronics, and lasers). Increasingly sophisticated, multifunctional systems are being produced, whose size is progressively being reduced while fuel consumption is being optimized. These systems include navigation, communications, and guidance systems, as well as data display systems using cathode ray displays.

An example of the new sets of equipment available on the market and integrated with the ones referred to above is represented by systems for optimizing management of the flight plan, producing major financial savings and alleviating pilot fatigue.

The more recent civil aircraft have already been certified with fully digital avionics (in some aircraft the system architecture comprises as many as 150 computers and microprocessors, with approximately four megabytes of installed software in programs and databases. Besides controling the cabin functions, these architectures control the electrical system, the pressurization and air conditioning systems, the braking system as well as other systems). Moreover, this is a sector in which the transfer of technology from even more sophisticated space systems and military systems is becoming relatively direct and dynamic, despite the fact that, when applied at a commercial level, the results achieved have to be balanced against other requirements such as the financial aspect and reliability.

In the next few years, there will be a spread of basic applications of technologies such as VLSI (Very Large Scale Integration) and VHSIC (Very High Speed Integrated Circuits), and of the replacement of electrical cables with fiber optic cables (which, moreover, reduce problems of electromagnetic shielding) (Figure 5).

Propulsion and Rotors

Simultaneous developments in advanced materials, control systems, digital fluid thermodynamics and heat transmission are being applied for the production of new propulsion systems, a sector in which the prospect of adopting more innovative cycles is accompanied by proposals for new system designs.

These include a number of original propulsion concepts that are currently being studied and soon are to be tested. For example, a traditional turbofan gas generator is coupled to new types of

propellers, used either singly or in a counter-rotating configuration, thereby exploiting the "propfan" principle (multiple blade propeller with pronounced propeller blade curvature and a high degree of sturdiness).

A large number of solutions are being studied today in this sector. A variety of problems in spacific technologies still have to be solved, such as those concerning the structural dynamics of blades made of composite materials and vibration phenomena. Over the next few years, propulsion systems probably will be produced that will offer an alternative to the turbofan.

In the rotors sector, on the other hand, the technology of blades made of composite materials with elastomeric jointing has been consolidated, and it is now possible to produce optimized rotors for different operating conditions, for example, placing greater emphasis on low speeds.

Today, great emphasis is being placed on research aimed at introducing new propulsion principles in propfan engines. It is estimated that, compared to the most advanced conventional turbofan engines, these engines will guarantee a reduction in consumption of 25 to 30 percent. This reduction is achieved by the use of special large-diameter propellers (fans) with a special configuration. Unlike conventional blades, these fans make it possible to achieve a propulsion speed very close to that of modern turbofans.

In the sector of large propulsion systems for transportation aircraft, only one company in Europe, Rolls Royce, possesses the technological capabilities and market position to be able to stand up to competition from the American companies General Electric and Pratt & Whitney.

However, the costs of development and certification of new engines are so high that "diversified" consortiums are being created for the production of specific engines.

--PW 2037	: Leader:	Pratt & Whitney/Partners: MTU and Fiat Aviazione.
--PW 4000	: Leader:	Pratt & Whitney/Partners: Fiat Aviazione, and Kongsberg.
--CF6 - 80C2	: Leader:	General Electric/Partners: Fiat Aviazione, Volvo, MTU, Rolls Royce and SNECMA.
--V 2500	: Leader:	International Aero Engine/Partners: Pratt & Whitney, Rolls Royce, JAEC, MTU, and Fiat Aviazione.
--CFM 56	: Equal partners:	General Electric and SNECMA.

The commercial struggles in progress today are the following:

PW 2037 ----------RB 211-535 (an agreement exists whereby General Electric gives assistance to Rolls Royce).
PW 4000 ----------CF6 - 80C2
V 2500 ----------CFM 56.

These struggles take the overt form of "concessions" concerning prices and services granted by engine manufacutrers to airlines aimed at eliminating the competitor's engine from the market.

However, healthy financial resources are needed if companies are to be able to hold out for a sufficiently long time in a price war of this kind.

The following international collaborative agreements have been made in the sector of small turboshaft propulsion systems:
--Fiat Aviazione/Pratt & Whitney Canada for the 1000 HP, PWC PT6 engine. Fiat makes the power gearbox and the gearbox for the ancillary controls of this engine. The first application is on the S76 Sikorsky helicopter.
--General Electric/Fiat Aviazione, for the GET700 engine and more powerful versions of this engine for civil use (the 1000-2200 HP version);
--Turbomeca/Rolls Royce/Piaggio, for the 2000-2500 HP, RTM 332 engine.
--In the sector of engines for fighter aircraft, Europe is seeking to become independent of the United States.
--The Turbo-Union company has been created by Italy (Fiat Aviazione), Great Britain (Rolls Royce), and West Germany (MTU) for the RB199 engine, installed on the Tornado aircraft purchased by these countries.

France prefers to work alone, developing the engine for the Mirage 2000 on a joint basis with the SNECMA and Dassault companies.

It is hoped that France will decide to join the rest of Europe on the new European fighter aircraft (EFA).

Production Methods and Processes

--Italy still is in an inherently weak position since the country does not have the capabilities to design all the parts of an engine using modern technologies. This is particularly true of the compressor, the fan, and the high-pressure turbine. This means that, in any international collaboration agreements drawn up at a European level, Italy always is forced to take the same parts (gearbox, low-pressure turbine, nozzles, static structures), for which the country has a

reputation of "excellence" [portion missing in original text--FBIS] Fiat Aviazione, while Alfa Romeo participates in many international programs because of the extremely high standards this company has reached in the processing of the hot parts of engines. However, this does not qualify the Italian aircraft engine industry as a top partner.

Therefore, it would be beneficial if Italy could establish an independent technology program so that, in the future, it would be able to acquire the capabilities that are lacking at present and therefore would be in a position to take its place as an equal partner at a European level. This could also provide a way to carry on with the experience gained by Alfa Romeo Avio with the RB318 program in which a 650 HP turboprop engine was developed in Italy for which Alfa Romeo has recently obtained both RAI and FAA certification.

4. Italy's Position on the International Scene

4.1--In the industrialized countries of the world (excluding the Soviet Union), the aerospace industry employs a labor force of approximately 1.8 - 1.9 million. The United States accounts for 64.5 percent of this total, while Europe accounts for 25.6 percent. Italy accounts for 8.3 percent of this sector in the EEC countries (Figure 10).

4.2--The results achieved by the Italian aerospace industry are excellent in many respects. This is shown by the fact that Italy is ranked sixth in the international ratings for aerospace countries (always excluding the Soviet Union) and, over the last 10 years, has had one of the highest growth rates. Sales in 1983 totaled 3,600 billion lire. Exports represented 64 percent of sales, with peaks of almost 80 percent of some companies, producing a surplus of 1,600 billion lire in the balance of trade for the sector (Figures 11 and 12).

On the employment front, at the end of 1983 the aerospace industry employed a labor force of 42,400, more than 41.4 percent of which was located in central and south Italy. Over the 5-year period 1979-1983 the labor force increased by 4,400 (+10.1 percent). The figures for 1983 show that engineers and technicians, clerical staff, and management accounted for 44 percent of the total labor force, while blue collar workers accounted for 56 percent of the total.

4.3--If we examine the figures for employment in the aerospace industry in 1983 (Figure 13), the structure of the sector can be summarized as follows:

Fixed wing aircraft	18,900	44.6 percent
Helicopters	7,000	16.5 "
Space	2,000	4.7 "
Missiles	1,700	4.0 "
Engines	5,600	13.3 "
Equipment	7,200	16.9 "

If we compare these figures to the distribution of employment in this sector in the EEC (a comparison based on the 1981 figures, the most recent ones available) we obtain the following picture:

	Italy	EEC average (excl. S. Union)
Aircraft--missiles--space	67.8	47.8
Engines	14.4	23.7
Equipment	17.8	28.5
	-----	-----
	100.0	100.0

At this point, we should highlight certain important aspects concerning the structure of the Italian aerospace industry.

These are:

Helicopters--Given the average figures for this sector worldwide, the dimensions of the Italian helicopter industry are disproportionately large.

In terms of 1982 sales, the Italian helicopter sector accounts for 16 percent of the entire aerospace industry in Italy. This percentage is much higher than the world average (4 percent) and is the highest in Europe (Great Britain, 3 percent; the FRG, 4 percent; France, 8 percent). The reason for the size of this sector, which does not reflect the size of the domestic market (in 1981-1982 the domestic market absorbed only 10 - 20 percent of domestic sales for helicopters), can be attributed to the role played by Italy in previous decades (producing under licence, with exclusive rights for certain areas of the world) at a time when the American helicopter industry was occupied almost entirely in satisfying the demand from the U.S. Armed Forces in connection with the Vietnam war.

Space--In terms of size, the part played by Italian industry in space activity essentially is in line with the country's resources. It must be emphasized that this sector consists of a vast number of companies.

This seems natural, given that the space sector is in a process of rapid evolution and therefore is not yet ready for a process of rationalization and aggregation.

However, the fact that this sector is extremely fragmented raises the problem of how the sector can be consolidated at a national level, something that is necessary if a dispersion of energy is to be avoided, concentrating that energy on common objectives. As we shall see later on, a definitive solution to this problem still has to be found.

Engines and Equipment--The role played in the national aerospace industry by the sectors of engines and equipment is a good deal smaller than both the world average and the European average. With regard to equipment suppliers it must be noted that, objectively speaking, the reason for the size of these two sectors is that only a small number of national aircraft programs exist. In all countries, development of the equipment industry depends to a very large extent on the opportunities offered by either domestic programs or programs in which the country in question plays a major role.

4.4--According to 1983 figures, employment in the Italian aerospace industry can be broken down into the following areas:

* Research and development 15 percent
* Production 68 percent
* General services 17 percent

If we compare these figures to a breakdown into activity areas in the EEC countries, based on 1981 figures, we obtain the following picture:

	Italy	EEC average (excl. Italy)
Research and development	13.7 percent	21.1 percent
Production	69.5 "	59.7 "
Marketing	16.7 "	19.2 "
	-----	-----
	100.0	100.0

We can see from this that despite the considerable growth in the Italian aerospace industry in recent years, the resources allocated to R&D are still a good deal lower than the European average.

4.5--After the immediate post-World War II period, (manufacturing under licence and subcontracting), the Italian aerospace industry successfully managed to acquire development and production capabilities which allowed it to implement domestic programs in major production and market areas (tactical defense aircraft, training and medium-sized transportation aircraft and medium-light helicopters). These capabilities have also enabled this sector to participate in a variety of international cooperative programs, including those in the more important sectors of the market (advanced defense aircraft, commercial jets, "level three" transportation aircraft and medium-sized helicopters) and programs involving advanced technologies (composite materials).

Figure 14 outlines the development of the aeronautics industry after the war. Engines was another sector that managed to acquire considerable technological capabilities as a result of production under licence, and these capabilities have made it possible for Italy to participate, with shares based on the size of the sector, in major programs to produce engines, as well as to be given responsibility for R&D.

With regard to the space sector, Italy has acquired the capabilities necessary to develop space systems, or to participate in international cooperative programs in the various segments of the market (launching systems, telecommunications satellites, scientific satellites and satellites for applications, and space transportation systems). In particular, Italy plays an important role in joint European programs, which are currently managed by the ESA [European Space Agency].

The effective programming of independent space activity using the National Space Program and periodic revisions of this program must also be emphasized.

4.6--In addition to what has already been said concerning individual sectors, there are also certain major "weaknesses" common to the entire aerospace industry in Italy. These weaknesses are as follows:

- --The small size of the domestic market, which obviously has a major effect on strategies concerning future participation in joint ventures and the acquisition of substantial shares of export markets;
- --The fact that the industry is not fully rationalized (this is a process that was started in the late 1960s, following the directives issued by the planning authorities, but has not been fully developed);
- --The fact that government intervention in this sector has been less decisive than in other countries.

4.7--Overall, the Italian industry has achieved positive results, especially when one considers the major constraints which have influenced the evolution of this sector.

However, future growth in this sector is threatened by a number of developments in the structure of the industry at world level which will tend to restrict the amount of "space" granted to medium-sized aerospace countries such as Italy, using mechanisms aimed at concentrating and redistributing participation, in favor of "new" aerospace countries.

5. Promotion of Technological Development of the Italian Aerospace Industry

5.1--From what has been said in the previous sections it is clear that the future of the Italian aerospace industry, consolidation of the position achieved in this sector by Italy and possible growth of the sector are all dependent, in terms of technology, on the ability of this industry to meet three objectives. These are:

- --Maintain the country's position vis-a-vis the other major aerospace industries in Europe in terms of improving the general technological level of both products and processes;
- --Take action in certain business areas to achieve a position of leadership, in order to acquire long-term competitive advantages (not only in aeronautics or space systems but also in components, subsystems, technologies, or specific functional expertise);
- --Maintain and strengthen an overall technological advantage over newcomers to the aeronautics industry.

5.2--In order to achieve these objectives--given the highly competitive nature of the sector at world level--Italian aerospace companies must be able to operate within the framework of an industrial policy for the aerospace sector which provides a context that will ensure that they are not at a disadvantage with respect to partners and competitors.

Some of these contextual conditions are not peculiar to the aerospace sector, affecting other industries as well.

Given the importance that two of these conditions have for the aerospace sector, they should be mentioned. These are:

- --Implementation of an overall policy for the promotion of research and innovation (this would also mean, moreover, that the necessary premises would have to be created for the programming of research and for an efficient system of subsidies);
- --The creation of institutional links between universities and industry, essential to stimulate a reciprocal flow of ideas and

experience (these links are, moreover, absolutely indispensable if engineers for industry are to receive adequate basic training).

5.3--There are also other conditions that are of specific interest to the aerospace sector.

While the importance of the first category of conditions must not be underestimated, attention is focused on the second category. The most important of these are listed below, and all involve intervention needed at a structural and institutional level:

--Creation of research structures in the aerospace sector;

--Creation of legislation for cooperation in research and development at an international level;

--Implementation of "specific" structures for the management of space activity.

A) Research Centers

For a number of years CIPE [Interministerial Committee for Economic Planning] has been planning to establish specialized research structures in the aerospace sector, similar to the structures that have existed for some time in all countries with an advanced aeronautics sector (with a decision made in December 1969 approving the Caron report; a decision made in September 1972 to locate such activity in the Naples area; and finally, a decision made on 20 July 1979 to establish the Italian Center for Aerospace Research (CIRA).

A group of engineering companies (Italimpianti, Fiat Engineering, Technipetrol, and Breda Design and Construction) has conducted a feasibility study which shows that the fundamental objectives of CIRA are the following:

--The acquisition and consolidation of know-how in the aerospace sector;

--The provision of incentives for companies in the sector to implement R&D programs, by means of a reduction in research and experimentation costs;

--The acquisition and constant review of state of the art expertise by the acquisition and preparation of information and data on technological know-how, and related documentation.

This study has also brought to light the following aspects:

--An investment of approximately 300 billion lire will be needed to create the CIRA (equivalent 1983 prices). Of this total, 157 billion lire will be needed to produce the systems considered as immediate necessities (wind tunnels, one with a high Reynolds number; a shielded chamber for testing for electromagnetic compatibility; a chamber for environment testing; systems for the testing of

electrical and hydraulic equipment and for the qualification and acceptance testing of systems and components; and technology laboratories for the testing of advanced materials).

--The center will employ 250 people; the annual operating costs will be approximately 18 billion lire (equiv. 1983 prices).

This study is now being examined by the authorities, until approval of the technical configuration of the center is received.

With regard to finances, the first step was taken in 1984, with an allocation of 35 billion lire for the start of construction of the center. What now has to be done is to establish the most suitable forms of financing for funding the completion of the center, as well as the financing required to run the center. The latter is an aspect for which industry should not be made financially responsible, as this would place it at a disadvantage with respect to the industries of other countries. Decisions are also needed concerning the way in which management of the center should be structured. Given the need to ensure that industry is suitably involved, an appropriate solution could be to entrust the running of the center to the CIRA consortium, which has already been established on an "ad hoc" basis by the regional authorities of Campania, with the participation of the leading companies in the sector.

B) Support for International Cooperation in Research and Development

In the aeronautics sector, the evolution of technology (both innovation and research) is closely linked to programs. Therefore, in the world context, which is characterized by an increasingly strong trend toward internationalization of aeronautics business, it is particularly important that support is given to research and development activity carried out as part of international cooperative programs if the technologies used in the aerospace industry are to develop and grow. For this purpose, it is essential for Italian companies participating in programs of this kind to be able to work in conditions comparable to those in which their "partners" work. In countries with an advanced aeronautics sector--and here we are referring particularly to European countries-- the state provides firm support for the development phase (as well as the other phases of the program), usually providing interest-free loans for what are referred to as non-recurring expenses. Intervention of this kind is established under the terms of D.D.L. [Parliamentary Bill] 1069/AS concerning "intervention aimed at making industries operating in the aeronautical sector more competitive."

The objective behind this bill is to support the participation of Italian companies in international cooperative programs. If this

objective is achieved it would be extremely beneficial for the promotion of technological development in this sector.

C) Management of Space Activity

The problem concerning the creation of an organization responsible for the management of space activity has been evident ever since the first "National Space Program" was prepared.

At the time (1979), a temporary solution was adopted consisting of entrusting the management of the National Space Program to the CNR [National Research Council] on a temporary basis, with the proviso that a definitive solution would be implemented at a later date. The size of Italian space programs today in various sectors and the extent of the commitments in international programs (particularly the programs managed by ESA, whose Columbus project will assume great importance in the near future), now mean that the implementation of concrete initiatives in this direction can be postponed no longer.

The competent authorities have decided that the most appropriate solution would be to create an agency which would be responsible--under the supervision of the Ministry of Scientific and Technological Research and in accordance with the guidelines for space policy approved by the planning authorities--for managing both domestic programs and Italian participation in international programs. This agency will have to adopt streamlined procedures which are modern and innovative compared with the procedures traditionally followed, and which experience has shown to be totally inadequate.

Until an agency of this kind is established, however, it is absolutely vital that an "interim" solution be adopted that will enable the sector to continue with the program of the National Space Program.

5.4--In terms of the "approach" of government authorities, what is needed is state-sector demand in the aerospace sector, offering the latter a concrete opportunity to pursue technological growth objectives. Demand of this kind could be implemented through programmed purchasing of aeronautical and space systems to meet the needs of the country as a whole, and through research contracts. At this point, rationalization of state-sector demand for research and development becomes absolutely essential in order to prevent the dispersal of funds allocated for this purpose, while at the same time acting as a catalyst which, by concentrating the available resources on priority projects, allows the "critical mass" to be reached.

Finally, one aspect that must not be underestimated concerns measures to encourage "technological spinoffs" in other production areas.

As things stand today in Italy, the situation in this respect certainly is unsatisfactory, since there are no structures and/or incentives to encourage spinoffs of this kind.

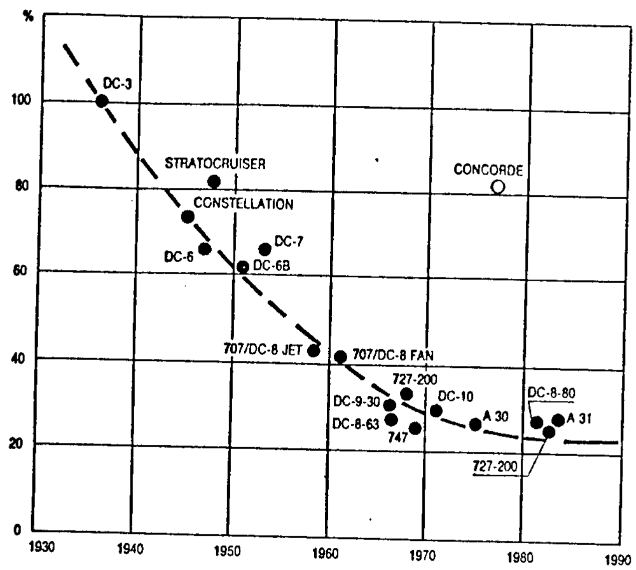
The creation of CIRA will represent the first step toward ensuring technological spinoffs from the aerospace sector. Following models already adopted in other countries (such as the structure and operation of NASA), CIRA could be given responsibility for this in the following areas:

- --The creation of databases;
- --The organization of seminars and special courses;
- --The creation of links between companies, researchers, and technical personnel both in the aerospace sector and in other sectors.

In addition, legislation could be introduced to facilitate the transfer of technologies developed by the aerospace industry to companies in other sectors (with a state-sector contribution to the cost, for example).

These measures would also have an "accelerator" effect on aerospace research work, thanks to the reduction in the related costs which companies have to face.

Figure 2--Evolution of the Operating Costs of Civil Aircraft



Direct operating
costs per seat/
mile
(in relative terms
DC-3 = 100 percent)

Figure 3--New Technology Benefits in Terms of Fuel Efficiency

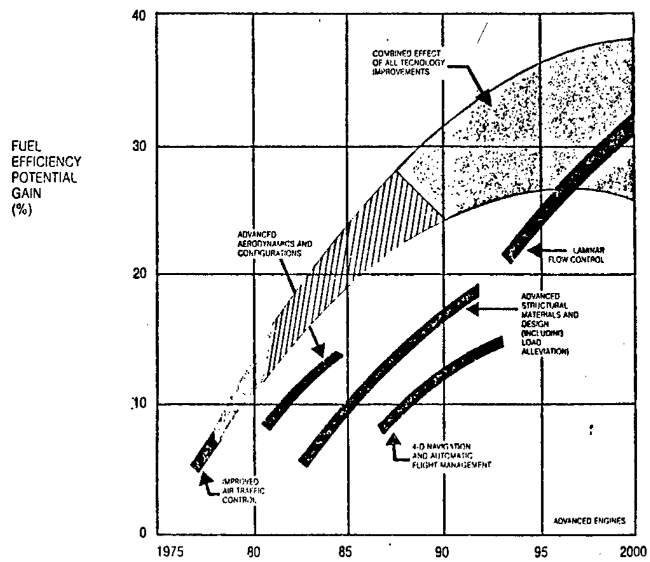
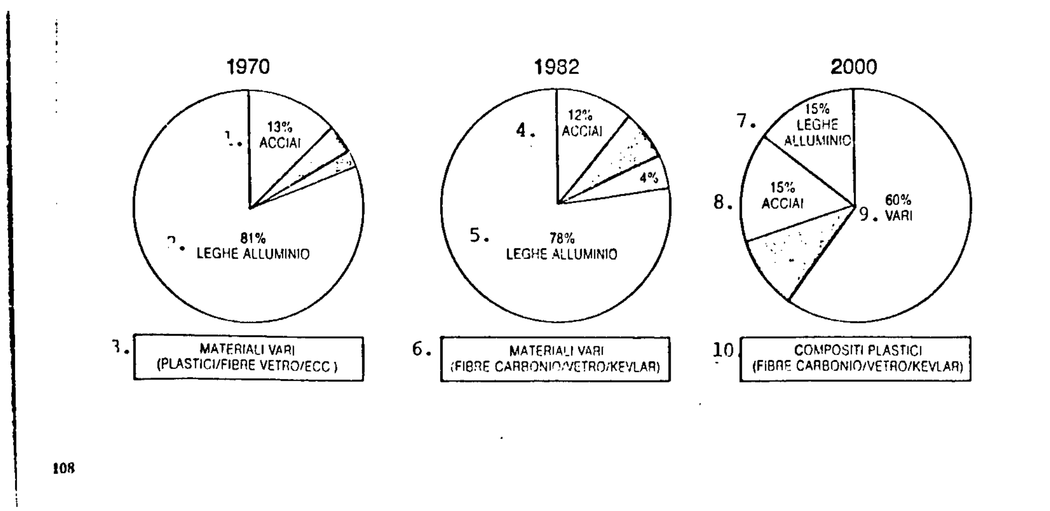


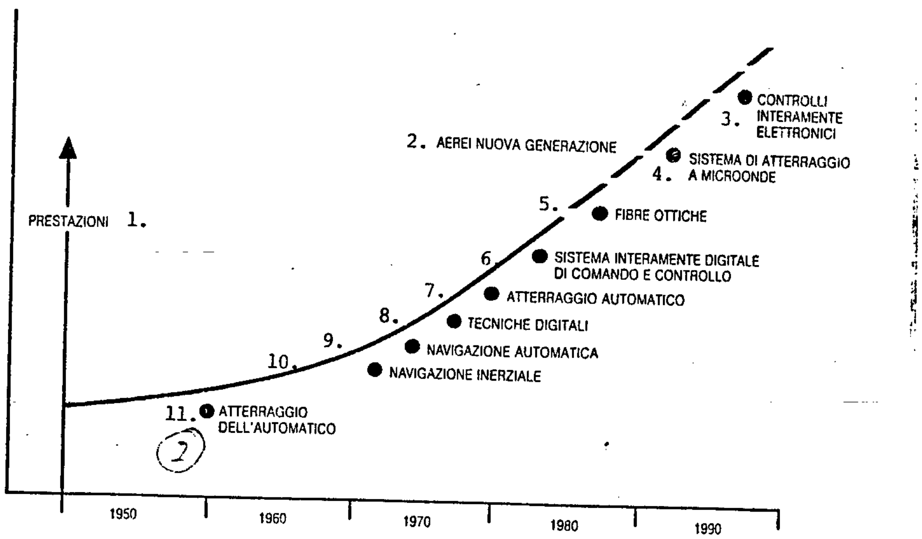
Figure 4--Commercial Aircraft: Percentage Breakdown of the Materials in Structures



Key:

1) 13 percent steel
2) 81 percent aluminum alloy
3) Various materials (plastic/ glass fibers/other)
4) 12 percent steel
5) 78 percent aluminum alloy
6) Various materials (carbon glass/kevlar fibers)
7) 15 percent aluminum
8) 15 percent steel
9) 60 percent various materials
10) Plastic composite materials (carbon/glass/kevlar fibers)

Figure 5--Evolution of Avionics in Civil Aircraft



Key:

1) Performance
2) New generation aircraft
3) Fully electronic controls
4) Microwave landing system
5) Fiber optics
6) Fully digital command and control system
7) Automatic landing
8) Digital technologies
9) Automatic navigation
10) Inertial navigation
11) Automatic landing

Figure 10--Employment in the Aerospace Industry Worldwide (excl. USSR). Estimated total: 1,850,000 employees

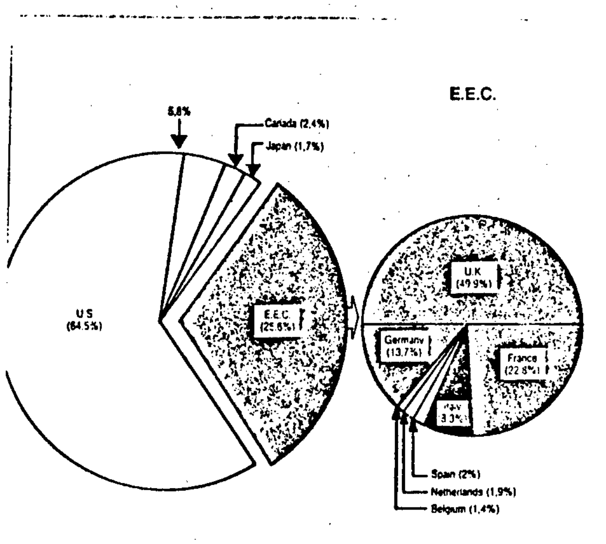
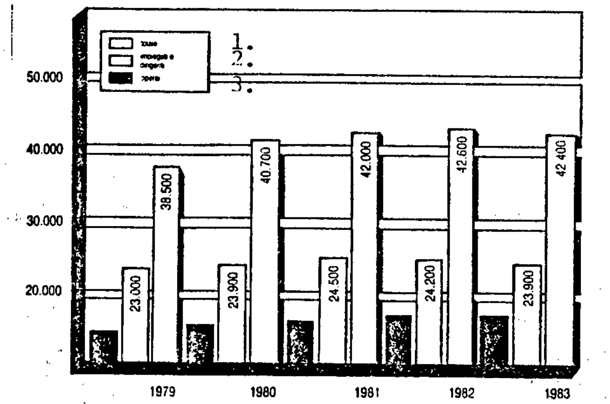
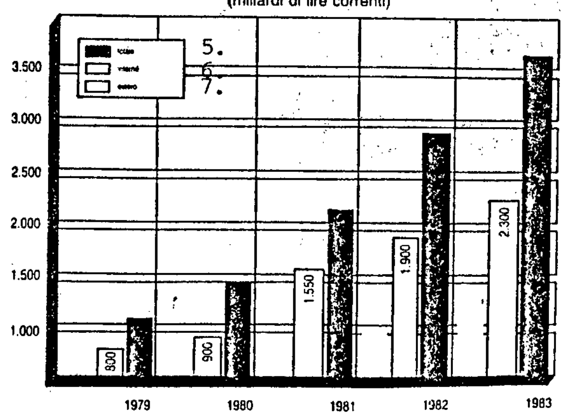


Figure 11--Employment (Nos. of employees)



4. ANDAMENTO DEL FATTURATO
(miliardi di lire correnti)



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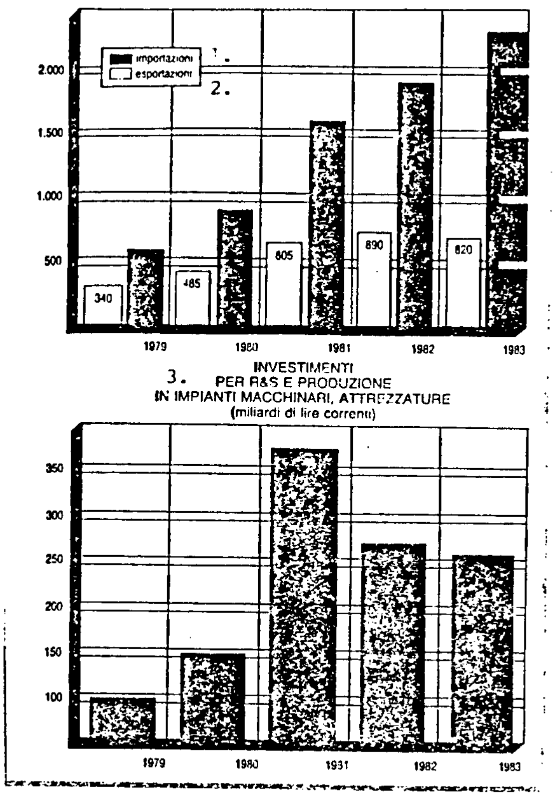
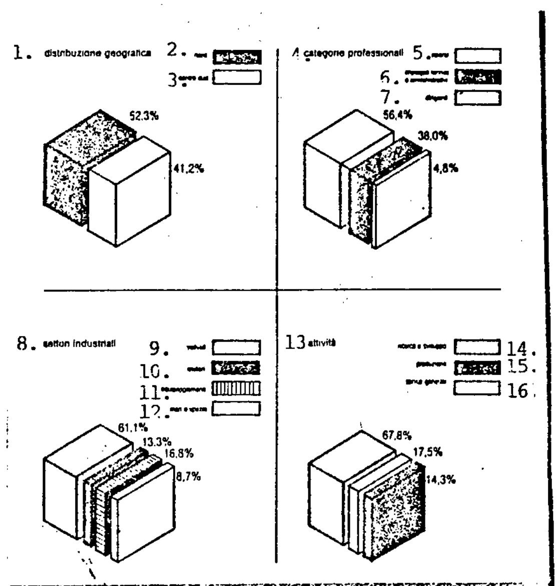
Key:
1) Total
2) Management and clerical staff
3) Blue collar workers
4) Sales (in billions of lire at current value)
5) Total
6) Italy
7) Abroad

Figure 12--Imports and Exports (billions of lire at current value)



Key:
1) Imports
2) Exports
3) Investments for R&D and manufacturing in plant, machinery and equipment.

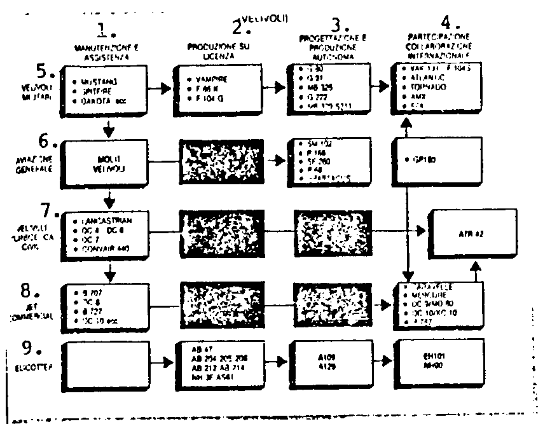
Figure 13--Employment in 1983 (42,400 people)



Key:

1) Geographical distribution
2) North
3) Center and South
4) Professional status
5) Blue collar workers
6) Technical and administrative personnel
7) Management
8) Industrial sector
9) Aircraft
10) Engines
11) Equipment
12) Marine and space
13) Activity
14) Research and Development
15) Production
16) General services

Figure 14--Pattern of Development in the Aeronautics Industry in Italy after World War II (Aircraft)



Key:

1) Maintenance and assistance
2) Manufacturing under license
3) Independent design and manufacturing
4) International cooperative agreements
5) Military aircraft
6) General aviation
7) Civil turboprop aircraft
8) Commercial jets
9) Helicopters

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- END -